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(54) Linear electron beam tubes arrangements

(57) An inductive output tube (IOT) includes an electron gun comprising a cathode 2, grid 3 and anode 4 surrounded by an annular resonant input cavity 7. RF chokes 5 and 6 prevent leakage of high frequency energy therethrough, the choke 6 nearer the grid/cathode region being shorter than the other to prevent or reduce high frequency parasitic oscillation.

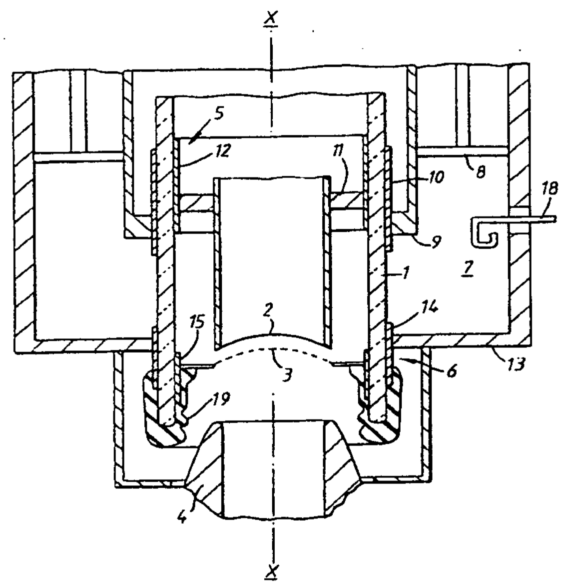

Fig.1

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Description

This invention relates to linear electron beam tube arrangements and more particularly to inductive output tubes (IOT's).

An inductive output tube is an arrangement in which a high frequency input signal is applied via a resonant input cavity to the region between the cathode and grid of an electron gun. This produces modulation of the electron beam generated by the electron gun. The resulting density modulated beam is directed to interact with an output resonant cavity from which an amplified high frequency output signal is extracted.

The present invention seeks to provide an improved linear electron beam tube arrangement.

According to the invention there is provided a linear electron beam tube arrangement comprising: an electron gun assembly which includes a cathode, grid and anode, and a high frequency resonant input cavity arranged about the assembly, the cavity having an inner part and an outer part which are connected via r.f. chokes and wherein the chokes are configured such that one choke nearer the cathode/grid region substantially prevents leakage therethrough of high frequency energy at a first frequency and another choke more remote from the cathode/grid region substantially prevents leakage therethrough of high frequency energy at a second frequency lower than the first.

By employing the invention, it is possible to reduce oscillation caused by feedback between the anode/grid gap and the grid/cathode gap which can otherwise occur by means of the higher frequency choke, whereas the lower frequency choke gives performance across the operating band. Thus the combination of the two chokes allows good performance at operating frequencies of the electron beam tube arrangement whilst reducing to an insignificant extent parasitic oscillation which can otherwise interfere with the operation of the tube.

In one particular embodiment of the invention, the higher frequency choke is arranged to reduce leakage through it of frequencies of the order of 800 MHz and above whereas the lower frequency choke can be arranged to reduce leakage at a frequency of say 400 MHz to 500 MHz.

Each choke is preferably configured as two or more co-extensive metallic portions, the length of the choke determining the frequency at which is effective. The metallic portions may, in one embodiment, be off-set from one another and may extend in a longitudinal axial direction substantially parallel to the electron beam direction or alternatively in a direction transverse to this. In one particularly advantageous embodiment of the invention, where the chokes extend in the axial direction of the tube, the chokes include ceramic material, which ceramic material may form part of a vacuum envelope of the arrangement. This provides a compact arrangement giving a small diameter for the arrangement as a whole.

The invention may be performed satisfactorily using two chokes but in other more complicated arrangements more than two chokes may be used. Also, although it is preferred that the co-extensive metal portions are substantially continuous, in some arrangements they may include perforations or breaks but this may lead to a loss of performance and again is more complicated.

High frequency energy absorbing material may also be included advantageously in the arrangement being arranged to at least partially cover portions of the choke means nearer the cathode/grid region which would otherwise be exposed, to thereby reduce feedback.

The metallic portions comprising the choke means may be metal plates which may also act as supports or mounts for other components of the electron gun or to locate and support the input cavity. One or more of the metallic portions may alternatively comprise a layer of metallisation deposited on the envelope. Such a layer need only be as thick as a few times the skin depth at operating frequencies and can be accurately deposited during fabrication of the arrangement.

Some ways in which the invention may be performed are now described by way of example with reference to the accompanying drawings in which:

Figure 1 schematically illustrates in longitudinal section part of an electron beam tube arrangement in accordance with the invention; and

Figure 2 schematically illustrates part of another arrangement in accordance with the invention.

With reference to Figure 1, part of an inductive output tube is shown in half section along its longitudinal axis X-X being substantially cylindrically symmetrical. It includes a ceramic cylinder 1 within which is contained an electron gun comprising a cathode 2, grid 3 and focusing anode 4 spaced apart in the longitudinal direction, the gun being arranged to generate an electron beam in use in the longitudinal direction. The cylinder 1 is sealed to an end plate via which electrical connections to components of the electron gun extend, the volume defined by the cylinder 1 and the end plate being at vacuum.

An input resonant cavity 7, which is substantially annular, is located coaxially outside the cylinder 1 and is positioned with respect to the electron gun such that when high frequency energy is applied to the cavity via coupling means, it results in a modulating electric field being produced in the cathode-grid region. This causes density modulation of an electron beam generated by the electron gun. The cavity 7 includes a tuning member 8 which is movable in a longitudinal direction to adjust the resonant frequency of the cavity 7.

One wall 9 defining the cavity 7 is an annular plate which extends transversely to the longitudinal axis. The wall 9 is integral with a metallic cylinder 10 which is secured to the outer surface of the cylinder 1. The cathode 2 is held in position by a support member 11 which

includes a cylindrical portion 12 secured to the interior surface of the cylinder 1 and co-extensive with the cylinder 10 in the longitudinal direction. The cylinder 10, support member portion 12 and intervening dielectric material of the cylinder 1 together define a first rf choke 5 to high frequency energy and in this arrangement, the length of the choke is designed to be a quarter wavelength at or near the operating frequency of the IOT to give across band performance.

The cavity 7 is further defined by another wall 13 which again is an annular plate transversely extensive with respect to the longitudinal direction and is positioned closer to the anode 4 than the first wall 9. The wall 13 is joined to a metallic cylinder 14 secured to the outer surface of the cylinder 1. The grid 3 is mounted within the cylinder and is connected to a metallic cylinder 15 which is adjacent the interior surface of the cylinder 1 and co-extensive with the cylinder 14 in the longitudinal direction. These metal portions 14 and 15 together with the dielectric material located between them form a second r.f. choke 6 to a substantially higher frequency than the first choke 5. In this case the choke 6 is substantially a quarter wavelength long at a frequency of approximately 800 MHz and reduces parasitic oscillation without significantly impairing the performance of the IOT. The choke 6 is partially coated with high frequency energy absorbing material 19, such as ferrite loaded silicone rubber and this also extends over the end of the ceramic cylinder 1.

The second rf choke 6 is thus substantially coaxial about the cathode/grid structure and the first rf choke 5, which is more remote from the cathode/grid region, is located behind the front face of the cathode 2 and is coaxially arranged about the longitudinal axis X-X.

In operation, the electron beam produced by the electron gun is modulated by a high frequency signal coupled into the input resonant cavity at 18. After modulation, the electron beam passes through an output resonant cavity from which the amplified output signal is extracted, typically via a double cavity arrangement.

The electon beam is then incident on a collector. One suitable output arrangement is illustrated in GB 2243943B.

In another arrangement, shown in Figure 2 two chokes 16 and 17 are again utilized but extend in a direction substantially normal to the electron beam direction, the choke nearer the cathode/grid region reducing or eliminating leakage of higher frequency radiation therethrough than the choke 17 to the rear of the electron gun and being significantly shorter than it.

Claims

1. A linear electron beam tube arrangement comprising: an electron gun assembly which includes a cathode (2), grid (3) and anode (4), and a high frequency resonant input cavity (7) arranged about the assembly, the cavity (7) having an inner part and an outer part which are connected via r.f. chokes (5, 6, 16, 17) and wherein the chokes are configured such that a first choke (6, 16) nearer the cathode substantially prevents leakage therethrough of high frequency energy at a first frequency and second choke (5, 17) more remote from the cathode and located behind the front face of the cathode (2) substantially prevents leakage therethrough of high frequency energy at a second frequency lower than the first.

2. An arrangement as claimed in claim 1 wherein the chokes (5, 6, 16, 17) comprise coextensive regions of conductive material and the first choke (6, 16) is shorter than the second choke.

3. An arrangement as claimed in claim 1 or 2 wherein one or both chokes (5, 6) include facing metallic portions which are extensive in the direction of the electron beam path.

4. An arrangement as claimed in any preceding claim and including a ceramic cylinder (1) and wherein one or both chokes (5, 6) incorporate part of the ceramic cylinder (1).

5. An arrangement as claimed in claim 1 or 2 wherein one or both chokes (16, 17) include facing metallic portions which are extensive in a direction substantially normal to the direction of the electron beam path.

6. An arrangement as claimed in any of claims 3, 4 or 5 wherein the facing portions of one or both chokes (5, 6) are off-set from one another.

7. An arrangement as claimed in any preceding claim wherein the first choke (6) is at least partially coated with high frequency energy absorbing material (19).

8. An arrangement as claimed in claim 7 wherein the first choke (6) includes ceramic material (1), and high frequency energy absorbing material (19) is located on the surface of the ceramic material (1).

9. An arrangement as claimed in any preceding claim wherein the first frequency is approximately twice the second frequency.

10. An inductive output tube (IOT) in accordance with any preceding claim.

11. A cavity arrangement for use as the input cavity of a linear electron beam tube arrangement in accordance with any preceding claim.

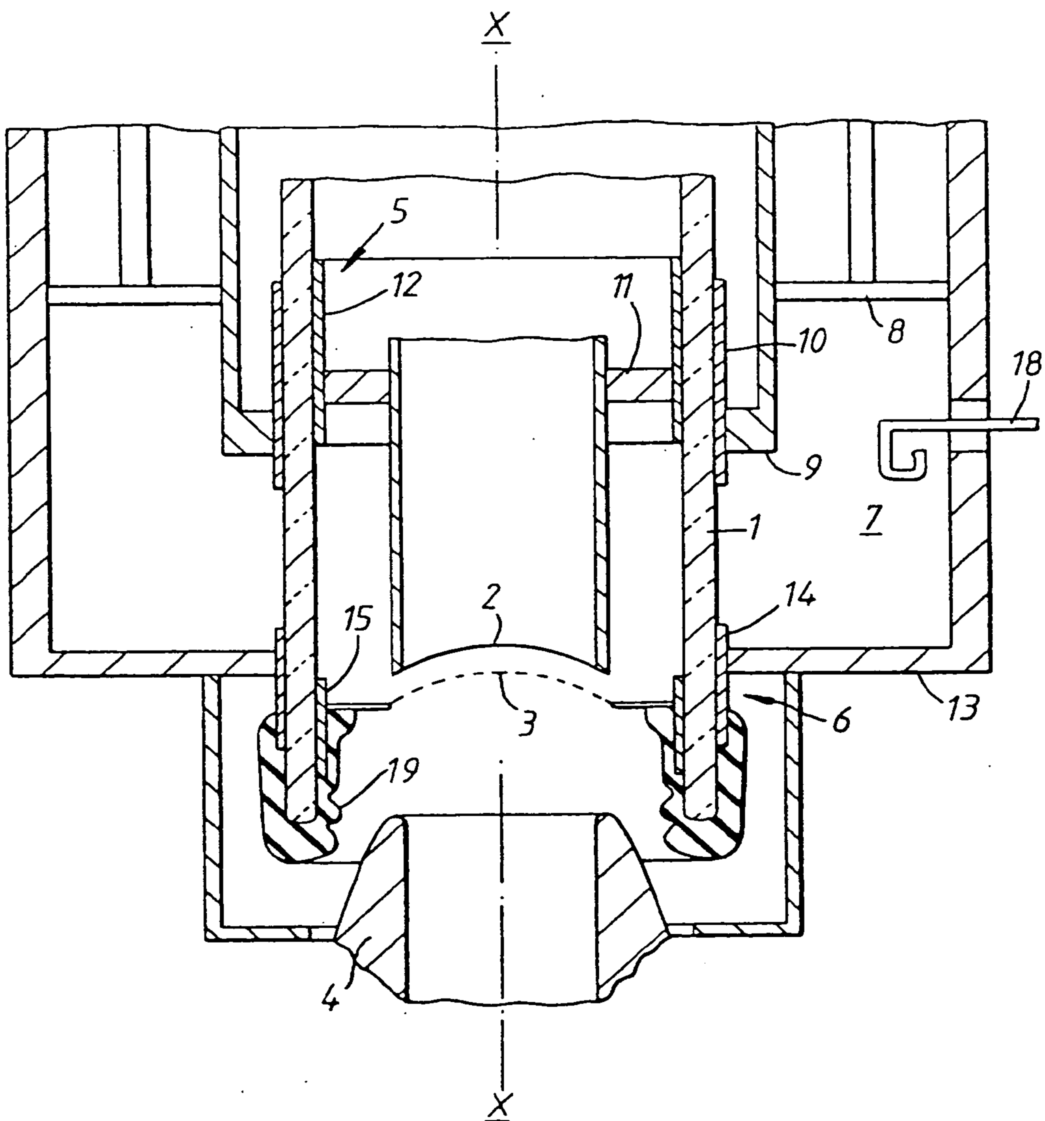

Fig.1

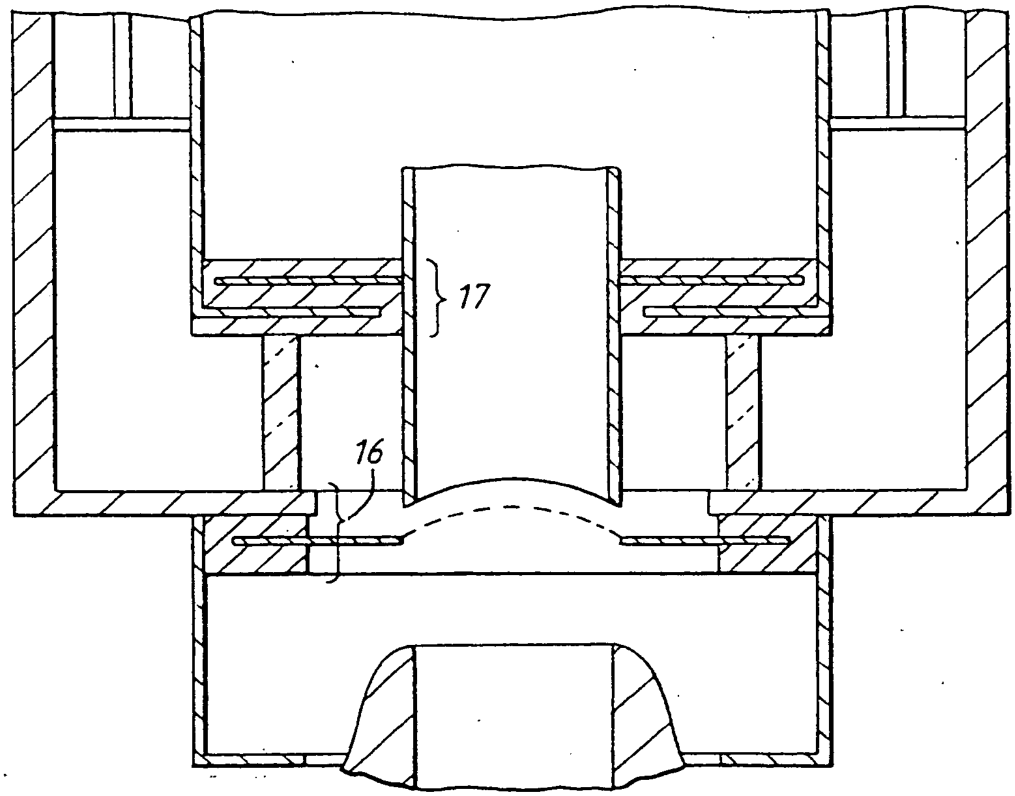

Fig.2

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EUROPEAN SEARCH REPORT

Application Number
EP 96 30 4892

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP-A-0 632 481 (EEV LIMITED) * abstract; figures * * column 1, line 48 - line 55 * * column 2, line 15 - line 40 * * column 3, line 39 - line 48 * ---	1-3,5-8, 10,11	H01J25/04 H01J23/15
A	EP-A-0 652 580 (EEV LIMITED) * abstract; figures * * column 2, line 3 - line 16 * * column 3, line 6 - line 13 * ---	1-4,6, 10,11	
P,A	EP-A-0 707 334 (EEV LIMITED) * abstract; figures * * column 1, line 44 - column 2, line 5 * * column 4, line 56 - line 59 * -----	1-4,6-8, 10,11	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			H01J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 October 1996	Martin Vicente, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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